

(12) UK Patent Application (19) GB (11) 2 381 377 (13) A

(43) Date of A Publication 30.04.2003

(21) Application No 0125447.3

(22) Date of Filing 23.10.2001

(71) Applicant(s)
Integrated Technologies
(Incorporated in the Netherlands)
Melkweg 18, 1188 LB Amstelveen,
Netherlands

(72) Inventor(s)
Irv Kon

(74) Agent and/or Address for Service
Marks & Clerk
57-60 Lincoln's Inn Fields, LONDON,
WC2A 3LS, United Kingdom

(51) INT CL⁷
H01L 35/32

(52) UK CL (Edition V)
H1K KTP K6A2B K6T1

(56) Documents Cited
WO 2000/008693 A1 WO 1999/040632 A1
JP 620067888 A JP 200107412 A
JP 110284235 A US 6262357 B
US 4095998 A

(58) Field of Search
UK CL (Edition T) H1K KTP
INT CL⁷ H01L 35/28 35/30 35/32, H01M 10/46, H02N
Other: Online: WPI, EPDOC, PAJ

(54) Abstract Title
Thermoelectric power generation device

(57) A Seebeck effect power generation device comprises a heat conductive base 11 which is heated by a heat source 12, a plurality of thermoelectric modules 14 separated by insulating layers 16 (eg high density foam) and a heat sink 13. The base 11 may be in contact with an engine block or cylinder head of an internal combustion engine, may have heat conveyed to it by a heat pipe, or may be heated by solar energy. The heat sink 13 may have fins which are cooled by an air flow. The thermoelectric modules 14 comprise banks of thermocouples (eg bismuth-telluride, bismuth-antimony, silicon-germanium) and the modules 14 may be connected in series or parallel to form an array having positive and negative electrical connections 17. The device may be used to charge a battery.

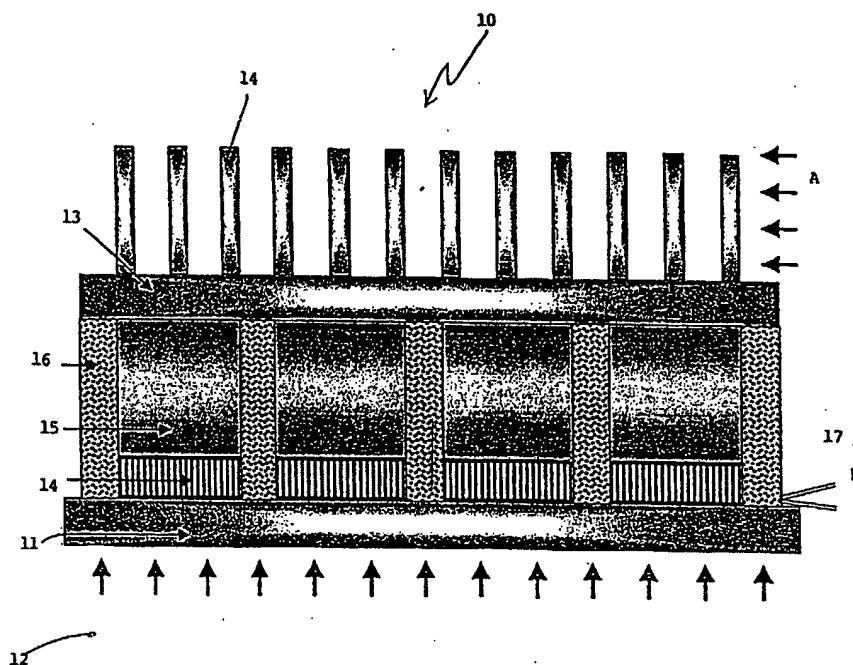


FIG. 1

1000000

11

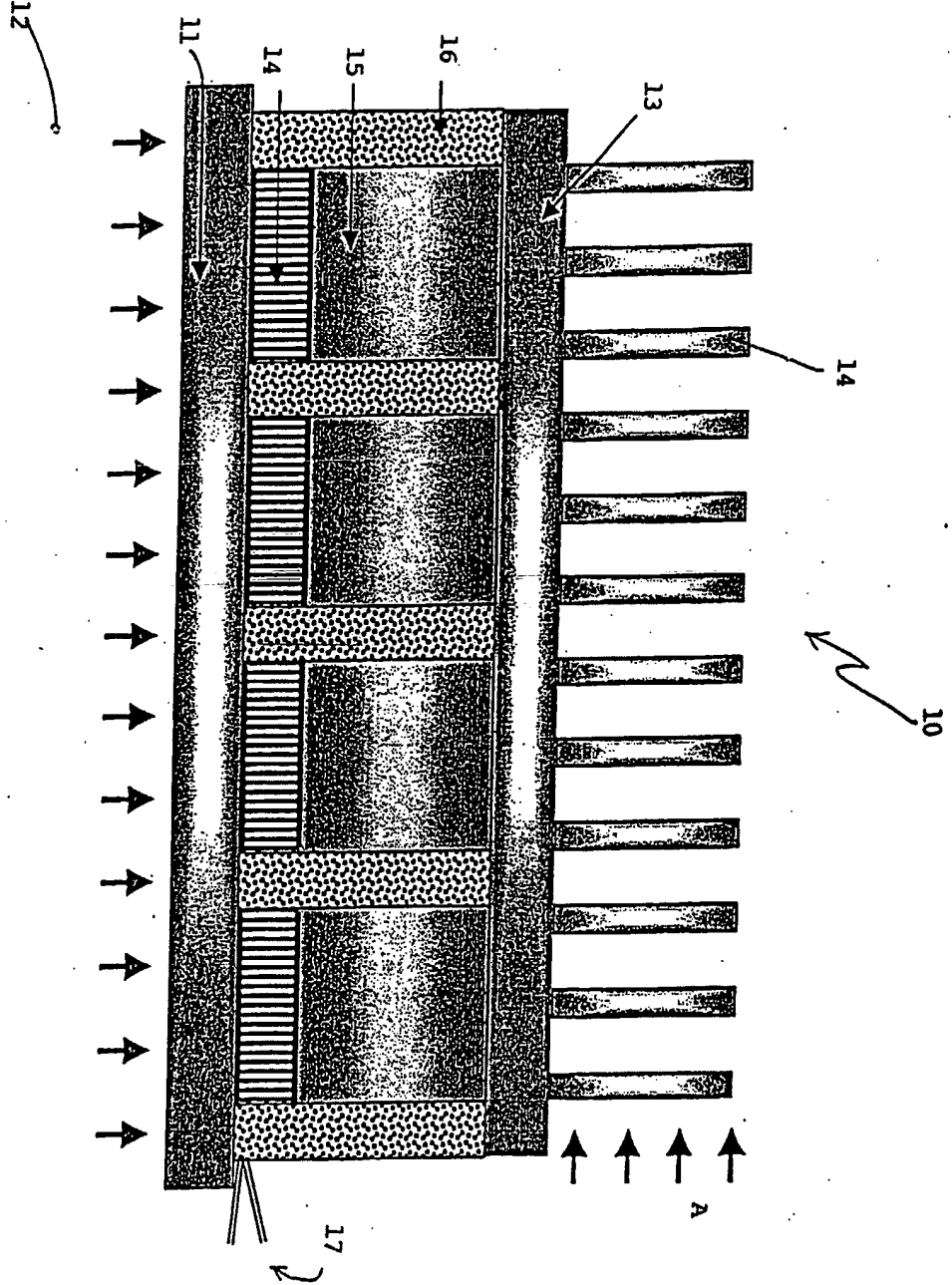


FIG. 1

ELECTRICAL POWER GENERATION DEVICE

Background of the Invention

5 The following invention relates to the conversion of otherwise wasted heat energy into useful electrical energy. More particularly, though not exclusively, the invention relates to equipment including an array of banks of thermocouple devices attached to an engine block or
10 cylinder head of an internal combustion engine and having an electrical output for charging an automotive battery.

An enormous amount of heat energy generated by internal combustion engines is wasted to atmosphere. Excess
15 mechanical energy of an internal combustion engine is used to drive an alternator which charges the automobile's battery. However, heat radiated or conducted from the cylinder head, engine block and exhausted system is released to the atmosphere, thus
20 contributing to known environmental problems, without being exploited for useful conservation of energy.

Object of the Invention

25 It is the object of the present invention to provide a means of converting waste heat energy or heat potential across an interface into a useful electrical potential difference.

Disclosure of the Invention

There is disclose herein electrical power generating
5 equipment including a generally planar heat conductive
base for intimate physical contact with a heat source and
a heat sink over the base that is arranged to be exposed
to a flow of air, including an array of banks of
individual thermocouple elements, each bank extending
10 between the base and the heat sink, such that an
electrical potential is generated across each bank when a
temperature difference exists between the base and the
heat sink.

15 Preferably, the heat source is an engine body.

Preferably, the heat sink includes fins.

Preferably, the fins are located in an area of cool air
20 flow.

Preferably, electrical conductors are attached to the
array of banks of thermocouple elements, the electrical
conductors serving to charge a battery.

25

Preferably, a regulator is attached to one or both of the
electrical conductors to prevent over-charging of the
battery.

Brief description of the drawings

A preferred form of the present invention will now be
5 described by way of example with reference to Fig. 1 which
is a schematic cross-sectional elevation view of an
electrical power generating device.

Detailed description of the preferred embodiment

10

In Fig. 1 there is schematically depicted an electrical
power generating device 10 including a generally planar
heat conductive base 11 for intimate physical contact with
a heat source 12. A heat sink 13 has a number of cooling
15 fins 14 attached thereto.

Between the heat sink 13 and base 11 there is provided an
array of banks of thermocouple elements (Peltier,
thermocouple devices etc) 14 and heat
20 capacitance/conductor blocks 15. Located inbetween the
banks of thermocouple elements 14 and
capacitance/conductive blocks 15 are insulating layers
16.

25 Connected to the array of banks of thermocouple devices
14 are positive and negative electrical conductors 17.

The exact configuration of the heat sink 13 depends on

the particular application's anticipated temperature conditions.

5 The insulating layers 16 might be formed of high density foam or other insulative material. The exact choice of material depends on the intended environmental temperature conditions.

10 The heat capacitive/conductive blocks 15 might be made of aluminium or another suitable good thermally conductive material. The typical thickness of these blocks might range from 0 mm (i.e. no blocks) to 80 mm or more depending on design parameters.

15 The thermocouple elements 14 might be connected in series or parallel. The elements might be bismuth-telluride. However, bismuth-antimony might be suitable in low temperature conditions (40-120°C). Silicon-germanium might be suitable for high temperature
20 conditions over 500°C for example.

A flow of Air might be directed over the cooling fins either directly or by way of ducting.

25 The base 11 might be permanently secured to an engine block or cylinder head for example, or might be attached thereto by way of conductive adhesive or welding for example. Instead, it might be bolted or screwed to the

heat source and have heat conductive paste applied between the heat source and the base. As yet a further alternative, the base 11 might be situated remotely from the heat source and might have heat conveyed to it for example by a heat pipe (a heat pipe is a construction of two pipes, one inside the other, where the space between the pipes is partially filled with a liquid that will evaporate at a chosen temperature if the inner tube is heated). When the vapour touches the cooler outside tube, the vapour will condense and revert to its liquid stage and evaporate again and so on). That is, the base might be located forward in the engine bay. For example, it might be fixed to part of the vehicle's radiator for example.

15

The electrical conductors might lead to a battery either directly or by way of conventional circuitry elements that might include a regulator. This will charge the battery instead of and/or in addition to a mechanically driven alternator or generator.

20

It should be appreciated that modifications and alternations obvious to those skilled in the art are not to be considered as beyond the scope of the present invention. For example, instead of being adhered directly to a heat source generating excess or unwanted heat, the device could receive solar energy that might be amplified or concentrated by optical means.

25

Also, the device is suitable for uses in any situation where there is a heat difference. For example, there is a heat difference between the passenger compartment of an
5 air craft and the outside environment, particularly at high attitudes. Devices like that disclosed herein might be used to convert this otherwise waste heat potential into useable electrical energy.

CLAIMS

1. Electrical power generating equipment including a generally planar heat conductive base for intimate
5 physical contact with a heat source and a heat sink over the base that is arranged to be exposed to a flow of air, including an array of banks of individual thermocouple elements, each bank extending between the base and the heat sink, such that an electrical potential is generated
10 across each bank when a temperature difference exists between the base and the heat sink.
2. The equipment of claim 1 wherein the heat source is an engine body.
15
3. The equipment of claim 1 wherein the heat sink includes fins.
4. The equipment of claim 3 wherein the fins are located
20 in an area of cool air flow.
5. The equipment of claim 1 wherein electrical conductors are attached to the array of banks of thermocouple elements, the electrical conductors serving
25 to charge a battery.
6. The equipment of claim 5 wherein a regulator is attached to one or both of the electrical conductors.



8



INVESTOR IN PEOPLE

Application No: GB 0125447.3
Claims searched: 1-6

Examiner: Stephen Jennings
Date of search: 12 June 2002

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): H1K (KTP)

Int Cl (Ed.7): H01L 35/28 35/30, 35/32, H01M 10/46, H02N

Other: Online: WPI, EPODOC, PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	JP 11-284235 (Union Material KK) See figures 1,6, paragraph [0021]	1-6
X	WO 99/40632 A1 (Israel Thermo Electrical Ltd) See figures 2,3, page 6 lines 23-30	1-4
X	US 6262357 B1 (International Business Machines) See figure 1	1-4
X	WO 00/08693 A1 (California Institute of Technology) See figure 6, page 3 lines 21-27, claim 5	1-2
X	JP 62-067888 (Thermovonics Co Ltd) See figure and PAJ abstract	1-4
A	US 4095998 (USA)	
A	JP 2001-7412 (Siird CT KK)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☒ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☒ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.